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**A Patient-Facing Dashboard to Promote *Shingrix*TM Vaccination in a Continuing Care
Retirement Community: A Quality Improvement Project**

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Abstract

BACKGROUND: Shingles is considered one of the most significant vaccine-preventable diseases of older adults based on its morbidity and public health burden, which increase drastically with age. Adult vaccine awareness and promotion programs are undervalued in the U.S.; in particular, educational programs targeting older adults are needed. Older adults have increasing rates of adoption of health information technology (HIT) to seek guidance and support for their medical needs. Leveraging HIT in the form of clinical dashboards is an option for providing reliable, safe and cost-effective vaccine education to older adults at high risk of vaccine-preventable disease.

METHODS: The specific aims of this quality improvement project were to increase knowledge and uptake of recombinant zoster vaccine (*Shingrix*TM) in older adults of a continuing retirement community (CCRC) through creation of a patient-facing clinical dashboard. The Four PillarsTM practice transformation program was used to guide implementation of the project including utilization of self-report surveys to determine baseline vaccination rates, perceptions of the dashboard and behavioral intention to receive future vaccination. The Patient Portal Acceptance Model (PPAM) was used as a theoretical framework to evaluate respondents' perceptions of the dashboard across four domains: ease of use, usefulness, self-efficacy, and privacy/security.

RESULTS: Respondents reported high levels of education and computer literacy. The majority reported using the internet for over 20 years and over 10 hours per week and 77.8% had used the internet to search for healthcare information within the past year. Baseline *Shingrix*TM vaccination levels in the CCRC were higher than national average but not at goal rates, and the majority of respondents eligible for vaccination did not plan to receive it. Respondents rated the

dashboard moderately high on perceived ease of use, low on concerns about privacy/security, high on ability to use independently (self-efficacy), and low on perceived usefulness.

DISCUSSION: The information provided by CCRC residents during development of this dashboard was valuable for elucidating motivators and barriers to HIT use in older adults, who largely view HIT as an adjunct to in-person interaction with a trusted provider. Improving older adults' perceptions of HIT will be critical in the era of Covid-19, when many high-risk older adults are seeking alternatives to traditional provider visits. Respondents were willing and able to access and navigate the dashboard; however, shingles knowledge did not improve in this small sample. Improvements in the presentation of the material on the dashboard may improve perceptions of usefulness and comprehension of specialized clinical information.

CONCLUSION: CCRC residents were receptive to receiving vaccine information via electronic dashboard and expressed interest in using this format as a source of other healthcare information. There is ample opportunity to expand patient-facing dashboards in the CCRC setting to provide a wide array of healthcare education for this population.

Keywords: patient portal, dashboard, health information technology, herpes zoster, shingles, recombinant zoster vaccine, *Shingrix*TM, vaccine, vaccination, older adult

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Introduction

Problem Description

Our global population is aging. As life expectancy increases, the number of adults over the age of 80 is projected to reach 400 million worldwide by the year 2050 (Gomensoro et al., 2018). Older adults are more active than prior generations, many leading vibrant, healthy lives and contributing significantly to the fabric of society (Doherty et al., 2018). This demographic shift has led to an increased focus on lifestyle factors to promote healthy aging, defined by the World Health Organization (WHO) as “the process of developing and maintaining the functional ability that enables well-being in older age” (*WHO | World Report on Ageing and Health*, 2015, p. 28). Healthy aging is influenced by both extrinsic factors such as the environment and intrinsic factors such as health-related behaviors, traits, skills and resilience (*WHO | World Report on Ageing and Health*, 2015). The benefits of healthy aging include both improved quality of life on the individual level as well as significant reductions in healthcare burden on a societal level (Doherty et al., 2018). Along with other preventative measures such as healthy diet and exercise, immunization against vaccine-preventable diseases (VPDs) is considered a vital component of healthy aging (Gomensoro et al., 2018).

VPDs cause significant morbidity and mortality in older adults; thus, an important metric to assess in this population is that of *vaccine-preventable disability* (Cunningham et al., 2021; Privor-Dumm et al., 2020). Through this lens, the goal of adult vaccinations should be to maintain function, maximize quality of life, and minimize complications in order to reduce functional decline and frailty. According to Cunningham et al. (2021), the three most significant

vaccine-preventable diseases of aging based on their morbidity and health burden are influenza, pneumococcal infections, and herpes zoster (HZ, or *shingles*). The CDC recommends vaccinations for these three VPDs for all adults over 65 regardless of health status (*Adult Immunization Schedule by Vaccine and Age Group* | CDC, 2021). Shingles, in particular, has a striking correlation between increasing age and risk of serious complications, including chronic neuropathic pain (post-herpetic neuralgia, PHN) and stroke (Cunningham et al., 2021; Gomensoro et al., 2018; X. Liu et al., 2016) .

Recombinant zoster vaccine (RZV), brand name *Shingrix*TM, is considered the gold standard for vaccine efficacy in older adults, as it drastically reduces the risk and complications of shingles that overwhelmingly increase with age (Cunningham et al., 2021). RZV has been shown to be cost-effective in terms of cost per quality-adjusted life-year (QALY) for older adults in a wide variety of settings, and maintains above 90% effectiveness in those over the age of 80 (Cunningham et al., 2021; Leidner et al., 2019; Privor-Dumm et al., 2020). While considered a good investment in all populations over age 50, vaccination with RZV becomes progressively more cost-effective with increasing age (Prosser et al., 2019).

Despite this potential, adult vaccination remains largely undervalued and a coordinated effort to support it is lacking (Tan, 2015). Limited, fragmented outreach coupled with complex public health recommendations result in low rates of awareness, a perception as unimportant compared to other public health initiatives, and a lack of knowledge of the benefits of vaccines (Gomensoro et al., 2018; Tan, 2015). However, provider recommendation is one of the top reasons that adults receive vaccines (Tan, 2015). Advanced practice registered nurses (APRNs) are successful primary care providers; studies have shown that outcomes for APRN-managed patients with hypertension, diabetes and heart failure are equal or better than those managed by

physicians (Wright et al., 2017). According to the American Association of Nurse Practitioners (AANP), over 75% of actively practicing APRNs work in primary care, providing an opportunity to address this gap and prioritize adult vaccinations as a public health initiative (*Nurse Practitioners in Primary Care*, n.d.; Wright et al., 2017). Including health care informatics in nurse practitioner graduate-level competencies facilitates the APRN to leverage health information technology (HIT) as a technique to improve patient outcomes.

Older adults have increasing rates of adoption of HIT as a way to seek guidance and support for their medical needs (Fischer et al., 2014). Options for utilizing HIT to disseminate vaccine information to older adults include patient portals or clinical dashboards. Given older adults' increased willingness to utilize HIT, this is a way to provide education on the value of adult vaccination and facilitate access to these services. Ultimately, however, the willingness to utilize HIT is impacted by the perceived quality of the information contained within it, which must be accurate, accessible, and clear. APRNs can seize this opportunity to use their skills as reliable, reputable sources of healthcare education to promote and facilitate access to technology-based resources for older adults. Collaboration with older adults to create a patient-facing dashboard may represent a new and effective way to disseminate information, drive investment, and motivate behavioral change related to immunizations.

Available Knowledge

A search of the literature was conducted using PubMed, CINAHL, and Google Scholar using the initial search phrases *older adult* or *adult*, *shingles* or *herpes zoster*, *vaccination rates* or *immunization rates* or *RZV* or *recombinant zoster vaccine* or *Shingrix™*, and *clinical dashboard* or *quality dashboard*. Publication dates were limited to the last five years as recombinant zoster vaccine was approved by the FDA in 2017 and because of the rapidly

evolving nature of HIT; however, relevant seminal studies were obtained from the references list. The literature review was limited to articles with full text readily available with many sites offering free access to vaccine-related literature in light of the current COVID-19 pandemic. Additional keywords were added to focus and refine the original search strategy as described in Aromataris & Riitano (2014).

The search results indicated that there is a wealth of available literature on vaccination with RZV in adults, as well as on the use of clinical dashboards as a way to support clinicians' decision making. However, less research has been done on patient-focused clinical dashboards, and other than for COVID-19, there were limited findings on the use of clinical dashboards for recommended adult vaccinations.

Vaccinations in Older Adults

The COVID-19 global pandemic has underscored the urgency of adult vaccination, especially of older adults who are at highest risk for complications from Sars-CoV-2 infection. Even before a COVID-19 vaccine was available, emphasis on its development highlighted the need for a system that could support a massive vaccination effort at the national and community level. The COVID-19 pandemic also stimulated increased focus on existing preventative methods for keeping older adults healthier, including routine vaccinations for other vaccine-preventable illnesses (Privor-Dumm et al., 2020).

The challenges to adult vaccination are significant and multifactorial. Undervalued in contrast to pediatric vaccination programs, adult vaccinations are also largely underprioritized by providers compared with other adult preventative services and screenings. For example, studies have shown that primary care providers are more likely to prioritize other preventative services, such as colorectal and breast cancer screenings over RZV vaccination despite comparable levels

of cost-effectiveness (Hurley et al., 2016; Leidner et al., 2019). Additional barriers exist due to confusion around payment, insurance coverage, and accessibility, as well as lack of infrastructure to develop, produce, and deliver vaccines (Gomensoro et al., 2018; Tan, 2015). RZV in particular is only available at pharmacies and not primary care practices or urgent care settings due to Medicare Part D billing regulations, limiting communication about availability and accessibility.

Herpes Zoster (Shingles)

Shingles is a viral syndrome caused by reactivation of latent varicella-zoster virus, the virus that causes chickenpox. The most common presentation of shingles is a painful vesicular rash in a dermatomal distribution that may be accompanied by generalized flu-like symptoms such as headache and malaise (*Clinical Overview of Herpes Zoster (Shingles)* | CDC, 2021). The acute phase of shingles causes intense dermatomal neuritis that has been described as burning, itching, numbness, tingling, aching or stabbing pain (Schmader et al., 2008). With an overall incidence of approximately 3 cases per 1000 people per year in the US, approximately 1 in 3 people will develop shingles in their lifetime. Its incidence also rises significantly with age, tripling to 12 cases per 1000 people per year in adults over the age of 60 (*Clinical Overview of Herpes Zoster (Shingles)* | CDC, 2021; Schmader et al., 2008). Adults over 60 and those who are immunocompromised are more likely to suffer from more severe acute herpetic neuralgia, which can be debilitating and has been shown in studies to contribute to impaired mental health, social functioning, and health-related quality of life (Schmader et al., 2008).

Older adults are also more likely to develop long-term complications. The most common complication of shingles is continued dermatomal pain after rash resolution, or postherpetic neuralgia (PHN). PHN can cause chronic fatigue, insomnia, depression and anxiety, impair

functional ability and reduce quality of life (Johnson & McElhaney, 2009). As more severe disease is a predictor of PHN, the incidence of PHN also increases drastically with age. Adults over 50 have an almost 15-fold higher rate of pain 30 days after shingles rash onset, and risk of PHN is almost three times higher in those over 80 than in those ages 50-54 (Johnson & McElhaney, 2009; Schmader et al., 2008). PHN pain can be exceptionally challenging to manage and usually requires a combination of agents that may include opioids, anticonvulsants, antidepressants and topical formulations, all with potential for their own adverse effects (Johnson & McElhaney, 2009). The cost of managing shingles and PHN also increases significantly with advancing age, and can reach over \$11,000 annually for PHN treatment in those over age 80 (Meyers et al., 2017).

Additionally, infection with herpes zoster can induce vasculopathy that leads to other serious complications. Particularly in older adults, this vasculopathy increases the risk for both thrombotic and hemorrhagic events and can exacerbate chronic illness such as cardiovascular disease and chronic obstructive lung disease (X. Liu et al., 2016; Privor-Dumm et al., 2020). This in turn increases the risk for functional decline and frailty, reduced quality of life or even death (Privor-Dumm et al., 2020). A meta-analysis by Liu et al. (2016) found that the relative risk of stroke after shingles infection is 2.36 in the first two weeks, 1.56 in the first month, and 1.17 in the first year.

Given the striking increase in incidence with age, the best way to prevent complications associated with shingles and PHN is to prevent initial HZ infection in older adults. Vaccination against shingles with two doses of *Shingrix*TM, two to six months apart, is highly effective with a 97.2% efficacy in adults over 50 and 90% efficacy in those over 70 (Cunningham et al., 2021). However, despite its effectiveness and the fact that RZV is recommended for nearly every older

adult, only about 35% of adults over 60 are vaccinated against shingles (Terlizzi, 2020). The priority must now shift from vaccines to vaccination; according to Gomensoro et al. (2018, pg. 186): “no matter how effective a vaccine may be, vaccine uptake is influenced by public and [provider] attitudes and choices...perceptions regarding the need for and effectiveness of established vaccines are key factors in vaccine uptake.” Leveraging HIT is an opportunity to increase outreach and public education that has previously been lacking.

HIT in Older Adults

Older adults are increasingly interested in technology as a way to access healthcare information (Fischer et al., 2014). However, older adults have specific barriers to the use of HIT, such as patient portals and community dashboards, in comparison with younger cohorts. Clinical dashboards in particular rely heavily on data visualization and graphics to provide information and inform behavior. Multiple factors make it harder for such visualizations to be meaningful and usable for older adults, including cognitive and sensory deficits, limitations in computer literacy and access, potential distrust of technology, and privacy and security concerns (Fischer et al., 2014).

In a qualitative pilot study, Young et al. (2014) interviewed adults ages 46-72 about perceived barriers to use of personal electronic health records (EHRs). Analysis of the interviews showed that attitudes toward HIT in this age group were influenced by four distinct themes: technological discomfort (computers being perceived as too impersonal or too complicated), privacy concerns (particularly about the idea of *hackers* of medical information), lack of relative advantage (not feeling like EHRs added anything over paper records), and an undesirable user representation (the idea that people who needed this technology were older, frailer, or had more comorbidities). In another qualitative interview study, (Turner et al., 2018) interviewed adults

over age 60 and revealed similar attitudes about distrust of technology. The majority of respondents in this study preferred health information to come from a familiar provider rather than the internet, citing concerns about the quality and reliability of the information (Turner et al., 2018). Searching the internet for health information was viewed primarily as a supplement to more trusted resources. This study revealed additional themes around self-efficacy and health literacy, namely that participants were not confident in their ability to distinguish valid sources from untrustworthy ones (Turner et al., 2018).

To develop and facilitate use of HIT that is actually beneficial to older adults, each of these barriers must be addressed. Older adults' trust of familiar providers is an opportunity for providers and practices to provide access to trustworthy sources of HIT, helping to avoid patient *googling* without confidence in the validity of the results (Turner et al., 2018). HIT directed at older adults should utilize familiar processes and applications, clearly demonstrate security and safety, and "align with older adults' active and engaged self-image" (Young et al., 2014, p. 127).

Previous work has suggested that outcomes are improved when the end-user participates in the development of HIT (Wu et al., 2020). This presents a significant challenge in older adults, as those who are more autonomous and computer-literate are more likely to participate in co-creation and user-testing of HIT, potentially widening the divide between those who are willing to consider HIT and those who are not (Wildenbos et al., 2018). To address this gap, Wildenbos et al. (2018) suggest that HIT should be co-developed and tested by patients with a variety of physical, motivational, cognitive, and motor deficits to ensure a true representative sample of end-users. While these studies focused on personal EHRs, there is a need for more research into development of all types of patient-facing visualizations in healthcare (Turchioe et al., 2019). There is limited research on what formats and graphics are optimal for patients to accurately

interpret healthcare information, a concept that is particularly important when developing patient-facing dashboards (Turchioe et al., 2019).

Clinical and Quality Dashboards

Visualization dashboards for local, state and national COVID-19 vaccination rates are becoming a familiar sight. In May 2021, the first 49 results of a basic Google search of the phrase *vaccination dashboard* yielded a wide variety of COVID-19 vaccination dashboards. These were typically created by individuals at the local community level, not-peer reviewed, and varied widely in style, use of graphics, and methods of disseminating COVID-19 vaccination information. Despite this heterogeneity, increasing familiarity with dashboards make them an appealing method to disseminate other healthcare information as well.

Use of clinician-facing dashboards has been shown to be successful in some healthcare settings, such as adherence to ventilator bundles in an ICU and opioid use monitoring in high risk communities (Dowding et al., 2015; Wu et al., 2020). Pathirannehelage et al. (2018) discussed the creation of a dashboard to disseminate information about influenza vaccine effectiveness within a large network of practices in the United Kingdom, with subjective success reported by the majority of practice sites. However, due to the heterogeneity of settings, variability in design, and differences in willingness of clinicians to accept them, it is not clear how clinical dashboards impact healthcare outcomes (Dowding et al., 2015).

While clinician-facing dashboards are fairly well established despite their variable outcomes, there is significantly less existing research on patient-facing dashboards (Turchioe et al., 2019). However, there is ongoing work in this promising area. One recent study developed a prototype patient-facing dashboard for patients with rheumatoid arthritis, which allowed them to input and then visualize their symptom severity over time, along with having access to their

medication list and recent laboratory results. Focus groups of patients with both high and low health literacy found the dashboard favorable and many felt it was a way to communicate more clearly with their providers or with friends or family (L. H. Liu et al., 2020). While clinicians expressed interest in the dashboard during focused groups, they expressed concern that it would overwhelm their patients and extend length of visits. Both clinicians and patients felt that the more the dashboard could be customized to the individual, the more effective it would be (L. H. Liu et al., 2020). A dashboard prototype for patients with diabetes was also developed successfully, with significant design improvements from the initial to the final prototype made by end-user focus groups (Martinez et al., 2018). These studies were of small size (25 patients in the rheumatoid arthritis study, and 14 patients in the diabetes dashboard study) and while the qualitative feedback is useful for design development, it is not clear yet whether these dashboards impact patient outcomes (L. H. Liu et al., 2020; Martinez et al., 2018). Ultimately, one of the biggest mediators of whether dashboards are effective in changing behavior and subsequently outcomes is whether they are actually used by their intended audience (Dowding et al., 2015).

Rationale

Many theoretical models have been developed to assess and predict behavior around use of technology. The dominant model for evaluating user behavior toward novel technological systems is the Technology Acceptance Model (TAM) which was developed over thirty years ago in response to a lack of understanding of users' acceptance of computers (Davis, 1989). The TAM incorporates the concepts of perceived usefulness, perceived ease of use, and behavioral intention as predictors of actual use of technology and has been widely adopted in the healthcare literature as a means to evaluate use of other types of HIT such as telehealth, EHRs, and mobile

health information technology systems (Holden & Karsh, 2010; Rahimi et al., 2018; Son et al., 2021).

While the original elements of the TAM are foundational to understanding the use of technology, the majority of its application in healthcare has involved development of extensions and modifications that incorporate additional clinician-centered components such as experience, training, and self-efficacy (Rahimi et al., 2018). The variety of extensions and adaptations of the TAM suggest that there is not one optimal version for use in healthcare and warrants ongoing development of models that are more predictive in healthcare scenarios (Rahimi et al., 2018). Further, the majority of TAM adaptations are intended to address *clinicians'* reactions to HIT (Holden & Karsh, 2010; Rahimi et al., 2018). The current project aimed to evaluate the central concepts of perceived usefulness and perceived ease of use as a predictor of dashboard use by *patients*; therefore, a patient-facing model incorporating the essential TAM elements was sought.

The Patient Portal Acceptance Model, or PPAM (Son et al., 2021), is based on the TAM and has been expanded to evaluate and explain factors related to patient-facing EHR or patient portal (PP) use. In addition to examining the TAM elements of perceived usefulness and ease of use, this model incorporates the constructs of eHealth literacy, data privacy, and security concerns as factors that influence PP use (Son et al., 2021). The model also directly accounts for age, education level, and perceived technological self-efficacy (Son et al., 2021). The inclusion of these factors made this model an appropriate framework for the evaluation of older adults, for whom data privacy, computer literacy, and low confidence in utilizing technology have all been identified as significant barriers to accessing health information.

To develop their model, Son and colleagues (2021) examined adult patients' perspectives on patient portal use with a 12-item Likert scale survey targeting four domains: ease of use,

usefulness, self-efficacy, and data privacy and security concerns. They also assessed overall attitudes toward patient portals and frequency of use over the past 12 months. The mean age in this study was 53.1 years and patients rated themselves as having relatively high health literacy. In this population, higher ratings of ease of use, usefulness, health literacy, and self-efficacy were associated with increased patient portal use. Older age and privacy concerns were associated with lower ratings of ease of use and lower self-efficacy (Son et al., 2021). This work examined and validated the factors that impact patient portal use in a large hospital system, and the authors recommend further exploration in diverse populations and settings.

A patient-facing dashboard includes many of the same technical components as a patient portal, including use of graphics and images to portray clinical information, and is similarly dependent on the user accessing and engaging with the information. Therefore, the PPAM was used as a framework to guide the development and assessment of older adults' perspectives of a patient facing *Shingrix*TM vaccination dashboard internally hosted for residents within the continuing care retirement community (CCRC). Measurement of the four domains addressed in the PPAM (ease of use, usefulness, self-efficacy, and privacy/security) is crucial to interpreting residents' use of the dashboard and for facilitating improvements in future iterations.

Specific Aims

The purpose of this quality improvement initiative was to promote *Shingrix*TM vaccination in independent residents of a CCRC through implementation of a patient-facing electronic dashboard. Specific aims included an increase in self-reported knowledge of the benefits of vaccination, increase in number of residents likely to receive the vaccine in the next 6 months, and an overall increase in the number of residents vaccinated against shingles. The measurable outcomes evaluated were 1) knowledge of the benefits of *Shingrix*TM vaccination on

a multiple-choice test 2) statement of intent to receive the two-dose *Shingrix*TM vaccination in the next 6 months or at some point in the future and 3) receipt of *Shingrix*TM vaccination during the intervention period.

Process measures were evaluated to assess whether the dashboard reached the intended audience. This was evaluated using a modified PPAM survey which assessed 1) whether or not the dashboard was accessed during the intervention period 2) overall attitude about the dashboard (positive or negative) and 3) evaluation of four domains (ease of use, usefulness, self-efficacy, and privacy/security). The goal was that the dashboard would be viewed positively by independent residents in the community and would impact their decision to receive *Shingrix*TM vaccination. When evaluated on a Likert-type scale, positive perceptions of ease of use, usefulness, and self-efficacy, and low levels of privacy/security concerns were anticipated.

Methods

Context

Better public health initiatives to promote adult vaccination, including *Shingrix*TM, are needed. Utilizing HIT is one pathway to promote such public health initiatives. Older adults are increasingly willing to use HIT as a way to receive healthcare information, but more work needs to be done regarding the factors that influence its use in this demographic. Visual dashboards are one type of HIT that could be used to influence behavioral intention to get vaccinated, ideally in a way that is cost-effective, sustainable, and reaches the intended audience.

Setting

CCRCs are a style of senior living with a focus on aging in place. CCRCs offer access to different levels of healthcare as care needs dictate, spanning independent living, assisted living, and long-term nursing care. CCRCs often focus on facilitating healthy aging, offering

opportunities for social engagement, exercise, activities, and access to healthcare (*Learn About Continuing Care Retirement Communities*, n.d.). This project was implemented at a not-for-profit CCRC in Northern New England.

Of the approximately 600 residents at the CCRC, about 80% live independently in private apartments and cottages. Independent residents maintain their own primary care and specialty care providers in the community, and additionally have access to an APRN-managed Wellness Clinic that aims to educate and facilitate access to healthcare. Essentially working in the residents' home, the APRNs at the CCRC have a unique role in the community, often developing close patient-provider relationships. The frequency of interaction, ranging from clinic visits, family meetings and community presentations to informal hallway consults, provides the CCRC APRNs with an opportunity to provide personalized, patient-focused education and care. This unique platform allows the opportunity to learn and review residents' healthcare choices and goals, including conversations related to vaccination status.

Immunization with *Shingrix*TM is currently not offered on site nor is it available at local primary care practices due to Medicare billing regulations. Currently, *Shingrix*TM is only offered at pharmacies, five of which are accessible by the complimentary shuttle service provided by the CCRC. In order to measure actual behavioral change in response to the intervention, the population being measured was independent-living residents for whom it was feasible to get transportation to one of the five local pharmacies. The CCRC shuttles are walker- and wheelchair-accessible, however the resident was required to have the necessary mobility to maneuver to and from the pharmacy or make advance arrangements to receive the vaccination in a drive-through format.

Resident Characteristics

There were 479 independent living residents of the CCRC at the time this quality improvement (QI) project was designed with 327 (68.3%) identifying as female and 152 (31.7%) as male. The average age of independent residents was 84.6 years (range 68 to 101), therefore *Shingrix*TM was recommended for all residents unless an individual had a previous allergic reaction to any component of the vaccine (*Shingrix Shingles Vaccination*, 2021). According to the EHR Business Analyst (personal communication, 4/16/21), 244 residents (50.9%) were married, 161 (33.6%) widowed, and the remainder (74, 15.4%) were divorced, never married, single or of unknown marital status. Marital status was assessed as a proxy for living arrangements because living alone is a predictor of lower uptake of some vaccines (Gomensoro et al., 2018). Average education level had not been formally evaluated at the CCRC at the time of project development and was not readily available in the EMR; however, it was known anecdotally that a very high number of residents had a minimum of a college degree. A question regarding highest level of education obtained was included in the modified PPAM survey; this was relevant to the intervention because uptake of *Shingrix*TM is significantly higher in people with greater than a high school degree (Terlizzi, 2020).

Project Team Members

The CCRC consists of three individual campuses. An adult/gerontology APRN at one of the three campuses was the project lead and immunization champion (IC). The IC developed and implemented the dashboard, promoted and monitored its use, and collected, analyzed and interpreted the data. Two APRN colleagues advised on the QI project to promote the dashboard to independent residents at the other two campuses of the CCRC. Community Life and Information Technology (IT) staff members who maintained other aspects of the resident portal collaborated on stylistic and logistical components of dashboard development. The Client

Services Director of the third-party web development company consulted with the project lead on technical aspects.

Web Portal

The interactive dashboard was hosted on a resident web portal which was managed by a contracted third-party company and implemented around the same time as this QI initiative. The platform was designed specifically for senior living communities to streamline processes and has functionality that includes digital announcements and calendars of scheduled events, ability to make dining and activity reservations, place work orders, message and share documents with staff, and with some versions to book an appointment (“About Viibrant,” n.d.). The portal was also advertised as having the capability to measure community and individual-level analytics to evaluate resident engagement with the portal. Although not all functionalities were fully optimized at the time of project implementation, the novelty of the system was expected to stimulate resident interest in its features including the *Shingrix*TM vaccination dashboard. The resident portal was managed by CCRC employees from the IT and Community Life departments in partnership with the third-party developer, all of whom collaborated and advised on the technical aspects of the dashboard.

Cost-Benefit Analysis

Costs associated with this project included consumables, personnel time, and web hosting. Cost consumables included paper and ink products for the pre- and post-surveys. Three \$25 dollar gift cards were raffled to respondents of the second survey to encourage participation. Personnel time included developing and pilot testing the dashboard, which involved the volunteer time of resident focus groups. Organizing and holding focus groups, updating subsequent iterations, data collection and analysis was done by the project lead at no cost to the

organization. The organization paid an initial fee to the web developer for the original resident portal along with monthly payments for ongoing support. There was no additional cost to the organization to add a Wellness Portal (which included the opportunity for multiple pages including the vaccine dashboard) to the existing portal. The Director of Client Services of the third-party web developer had 30- to 60-minute meetings with the project lead monthly. At this time, the project lead is maintaining the dashboard at no additional cost to the organization. However, as noted by the resident focus group, in order for this dashboard to be sustainable long-term, maintenance responsibilities should be transferred to a staff member's job description.

*Shingrix*TM is covered by nearly all Medicare Part D plans; some require copays for a portion of the vaccination or require initial payment in full and then provide reimbursement (*Shingrix Shingles Vaccination*, 2021). Just as with other preventative healthcare, CCRC residents who elect to obtain a *Shingrix*TM vaccination are individually responsible for any associated copays. There are currently no known residents without Part D plans at the CCRC, but in this rare case the resident would be responsible for the full cost of the *Shingrix*TM vaccine. Per GlaxoSmithKline, the makers of *Shingrix*TM, the list price for both doses is \$324.02 as of January 2021 (*Shingrix Pricing Information | GSKForYou*, n.d.).

The potential benefit is financial savings and quality of life maintained by the avoidance of shingles and its complications. The number needed to vaccinate with *Shingrix*TM to prevent one case of shingles is 10 individuals (Curran et al., 2018). At an incidence of 12 cases per 1000 people per year, it could be expected that 5 to 6 cases per year would occur in a totally unvaccinated population the size of the CCRC. Health care costs for shingles treatment increase with age: as of 2017, it was estimated that treatment for shingles in age 70-79 was \$2643 and over age 80 was \$3804 annually, and treatment for PHN in these age groups are \$8548 and

\$11,147 annually, respectively (Meyers et al., 2017). Encouraging 10 currently unvaccinated residents to receive both doses of *Shingrix*TM would therefore save somewhere between \$26,430 and \$111,470 in direct healthcare costs, and this does not include indirect costs associated with complications such as impaired mental health, poor sleep, and impaired functional ability.

Interventions

As the cause of under-vaccination in adults is multifactorial, a multifaceted approach to address behavioral, structural, educational and financial barriers to vaccination is needed. A research team from the University of Pittsburgh School of Medicine developed a QI program with a focus on this multifaceted approach, the 4 PillarsTM Practice Transformation Program (Lin et al., 2016; Nowalk et al., 2012, 2014; Smith et al., 2017; Zimmerman et al., 2017). Initially devised as a standing order program (SOP) toolkit to encourage non-provider medical staff to assess patient immunization status and administer appropriate vaccines, the toolkit was piloted in three primary care practices in 2010. Based on staff feedback of the barriers to implementation of the SOP, the toolkit was revised and expanded to focus on four distinct pillars: convenience of vaccination services, education and notification about the importance of and availability of vaccines, enhanced office vaccination systems such as EMR alerts, and motivation by an immunization champion who tracks and provides feedback on progress toward vaccination goals (Nowalk et al., 2012).

The 4 PillarsTM program has had modest success at increasing pneumococcal (PPSV23) vaccination rates in adults over the age of 65 (Zimmerman et al., 2017), increasing PPSV, influenza, and tetanus-diphtheria-pertussis (Tdap) vaccination in adults age 18-64 with high-risk conditions (Nowalk et al., 2017), and reducing missed opportunities for influenza vaccination in adults in primary care (Lin et al., 2016). Cost-benefit analyses demonstrate that even modest

improvements in immunization rates with this program are cost-effective and can have significant impact on cost of care at a public health level (Smith et al., 2017).

The framework of this project is based on a self-guided QI program modeled after the 4 Pillars™ Practice Transformation Program, which is freely available on the internet and guides implementation of evidence-based strategies from each of the four pillars while allowing the freedom to adapt to specific needs of the practice site (*Self-Guided Version | The 4 Pillars Practice Transformation Program*, n.d.). The self-guided 4 Pillars™ program employs a three-step process: 1) Determination of current vaccination rates, 2) Selection and implementation of evidence-based strategies (preferably at least one from each of the four pillars), and 3) Evaluation of improvement (*Self-Guided Version | The 4 Pillars Practice Transformation Program*, n.d.).

Step One: Determine Current Vaccination Rates

Baseline *Shingrix*™ vaccination rates in the independent residents of the CCRC were obtained from self-report survey. By multiple choice, respondents were asked to select all that applied (no vaccination, *Zostavax*™, one dose of *Shingrix*™, two doses of *Shingrix*™, unsure of vaccine status, and an open response for *other*). Chart review of the CCRC Wellness Clinics for vaccine information was found to be of limited utility as there is currently no standardized documentation of shingles vaccination status.

Two separate rates were intended to be calculated: percent fully vaccinated and percent partially vaccinated. Fully vaccinated rate was intended to be calculated by the number of residents who reported having received two doses of *Shingrix*™, divided by the total number of independent residents at the CCRC who were eligible for the vaccine. Similarly, partially vaccinated rate was intended to be calculated by the number of residents for which there was

documentation of one RZV vaccine, divided by the total number of residents who were eligible for the vaccine. However, due to the exclusive use of self-report survey rather than chart review, ultimately these rates were calculated with the numerator as described above and the denominator as the total number of survey respondents. Participants with previous Zoster Vaccine Live (ZVL; *Zostavax*TM) vaccination only were considered unvaccinated, consistent with the CDC recommendation for *Shingrix*TM vaccination for immunocompetent adults who previously received *Zostavax*TM (Dooling, 2018). If participants reported not knowing their vaccination status, they were identified as eligible for *Shingrix*TM vaccination. A goal of increasing vaccination rate by 20% over the implementation period is recommended by the 4 PillarsTM Program (*Self-Guided Version | The 4 Pillars Practice Transformation Program*, n.d.).

Initially, the plan to calculate percent fully vaccinated and percent partially vaccinated was influenced by anecdotes from residents in 2018-2019, when *Shingrix*TM was first available in the area, reporting that the vaccine was challenging to find at local pharmacies due to shortages and long wait lists. Interestingly, the self-reported vaccination rate did not bear this out, as only a small minority of residents reported having received only one *Shingrix*TM vaccine. To better reflect the aims of this project the decision was made to frame these categories as *fully vaccinated* vs. *eligible for Shingrix*TM *vaccination* with residents who had received only one *Shingrix*TM vaccination falling into the latter category.

Step 2: Select and Implement Evidence-Based Strategies

The 4 PillarsTM Program uses strategies from four areas: 1) convenience and easy access, 2) patient communication strategies, 3) enhanced vaccination system strategies, and 4) motivation strategies. It is recommended to use at least one strategy from each pillar to maximize outcomes. This program is tailored toward primary care office practices and this is the first time

it was implemented in a CCRC. Where feasible, strategies as recommended by the 4 Pillars™ Program were refined and adapted to fit the CCRC Wellness Clinic model; strategies related to the direct administration of *Shingrix*™ vaccine were omitted due to the practice setting.

A resident portal at the CCRC was implemented in July 2021 with community staff offering group and individual orientation to its basic functions throughout summer 2021. Within the portal, administrative users could create individual pages to suit their department's needs. Shortly after residents were introduced to the new portal, the IT project manager received feedback from independent residents who felt it was lacking a healthcare component. This provided the momentum for this project's prototype patient-facing dashboard to be translated and integrated into the existing resident portal. The dashboard aimed to support strategies from each of the 4 Pillars™ detailed in the self-guided program, including providing information about community-specific vaccination rates, benefits of vaccination, cost, local availability and convenience of services.

Pillar 1: Convenience and Easy Access Strategies. In the primary care setting, the goal of this pillar is to use any office visit as an opportunity to vaccinate, and to facilitate access with expanded hours, vaccination-only hours and walk-in availability (Smith et al., 2017). In the CCRC setting, this pillar was adapted to using office visits as an opportunity to introduce residents to the vaccination dashboard, review vaccination status, encourage vaccination at a local pharmacy, and review options for transportation to the pharmacy. The dashboard included links regarding availability at local pharmacies and transportation options.

Pillar 2: Patient Communication Strategies. This pillar emphasizes communication with patients and education about the importance of immunizations and the availability of vaccines (Smith et al., 2017). Educational resources were the main focus of the shingles

vaccination dashboard. The landing page of the dashboard contained graphics showing current vaccination rates, goal vaccination rates, comparison with national benchmarks, and intention to receive a *Shingrix*TM vaccine in the future. Initial plans for graphics also included a thermometer-type image to show overall progress toward the goal of a 20% total increase in *Shingrix*TM vaccinations over the intervention period. Due to competing vaccine priorities and a shortened intervention period, it became clear during early implementation that this goal was not realistic under the current constraints and this graphic was ultimately omitted. The dashboard contained answers to frequently asked questions about dosing, timing, billing and insurance coverage, as well as contact information for the nurse practitioner at each campus to address specific questions.

The dashboard was created with the end user in mind with a focus on accessibility and ease of navigation for those with limited computer literacy. Independent residents at the CCRC are required to undergo a cognitive and mobility assessment prior to move-in to ensure that their safety needs can be met in the community, and after admission must be able to manage their daily activities with occasional support for specific needs. Therefore, the dashboard was intended to support older adult residents with normal cognition and those with mild sensory, motor and cognitive deficits who were able to manage independently at home. Within the constraints of maintaining stylistic consistency with the rest of the existing resident portal, the graphics and functionality of the dashboard were developed by the project lead and pilot tested by resident volunteers who had previously expressed interest in improving use of technology in the community. All residents were provided login credentials to the resident portal whether or not they owned a personal computer or device, therefore the dashboard was available on any public

or personal device that could access the internet. Community life staff were available as needed to assist residents with logging in to the portal.

Pillar 3: Enhanced Vaccination System Strategies. This pillar involves standardizing processes within the EMR to facilitate vaccinations through accurate documentation, alerts and reminders, and standing order protocols. The EMR in use for this project is limited in its ability to generate alerts and a standing order protocol was not relevant for *Shingrix*TM as it cannot be administered onsite. Therefore, facilitating accurate documentation was the most attainable goal of this pillar, particularly as early attempts to obtain baseline vaccination rates revealed significant gaps in documentation. Initial plans for the dashboard included a standardized method of communicating vaccination information to the Wellness Clinics so it could be recorded in the EMR; however, this was not completed within the intervention period because of privacy and security issues within the existing messaging system of the portal.

Pillar 4: Motivation Strategies. This pillar involves “motivation through an office immunization champion who monitors progress and encourages adherence to vaccination-promoting office procedures to improve vaccine uptake” (Smith et al., 2017, p. 2). The project lead served as the Immunization Champion (IC) with the goal to promote the behavior change through motivational education, graphics and visualizations available on the dashboard. A unique addition to the original 4 PillarsTM model was added in the form of a “resident immunization champion” (RIC). The RIC was a pilot tester of the dashboard with high computer literacy and an interest in health promotion who endorsed the dashboard amongst their peers and assisted the project lead in finding opportunities to introduce and promote the dashboard.

Step 3: Evaluate the Improvement

The dashboard was introduced to residents during two presentations by the project lead, which were facilitated by the RIC. Approximately 15 residents with an interest in healthcare resources at the CCRC attended the first session, while the second session was a general meeting open to all residents with over 100 in attendance. After positive feedback from the initial group, the general meeting was publicized in advance with paper memos, digital signage and personal interactions with the Wellness Clinic team. During both sessions, residents watched a 15-minute slideshow demonstrating the functionality and purpose of the dashboard followed by a question-and-answer session.

The dashboard became accessible to all residents on the day of the second session, after which residents were requested to complete a paper survey of their perceptions of the dashboard using a modified version of the PPAM (Appendix A). Residents were asked to return the survey within two weeks. The dashboard remained available for the duration of the intervention period. In conjunction with the PPAM survey, residents were also asked to complete an eight-question multiple-choice shingles knowledge test. The shingles knowledge test was also made available to individuals who had not accessed the portal so that responses could be compared across these groups.

Study of the Interventions

The foundation of QI is changing both outcomes and care processes (Goodman et al., 2016). Therefore, following the intervention period it was important to assess whether residents actually utilized the dashboard and whether this influenced their subsequent behavior. Residents' perceptions and use of the dashboard was evaluated by analyzing responses on the modified PPAM survey (Son et al., 2021). Descriptive statistics were performed on demographic data (age, gender and education level) as well as the Likert-type items evaluating the domains of

eHealth literacy, ease of use, usefulness, self-efficacy, privacy and security concerns, and overall attitude toward dashboard use. Frequencies and percentage were noted for categorical data and mean, standard deviation and range were calculated for Likert-type items.

Aggregate scores on the shingles knowledge test questions were calculated to observe scores of those who had accessed the dashboard with those who had not. Findings from the shingles knowledge test and PPAM items will be disseminated to residents and leadership of the organization. Ideally this information can be used to make improvements or expansions to the dashboard, with the goal of this becoming a routine method of distributing clinical information at the CCRC.

Measures

Modified Patient Portal Acceptance Model (PPAM) Survey

Acceptance and perceptions of the dashboard were assessed with a survey modified with permission from Son et al. (2021, pg. 146). Son and colleagues combined other previously validated scales (eHealth Literacy Scale or eHEALS, Perceived Health Website Usability Questionnaire, Self-efficacy for Computer-Based Personal Health Record Scale) and survey items from previously validated work to create their survey. The survey was modified for this QI project to be site-specific and to reflect the intervention with italicized items noting these modifications (Appendix A).

Son et al. (2021) reported the internal consistency and construct validity of each of the previously validated scales used to comprise their survey. The eHEALS is internally consistent (Cronbach's $\alpha = 0.94$) and valid (Norman & Skinner, 2006; Son et al., 2021). The Perceived Health Website Usability Questionnaire (Cronbach's $\alpha = 0.95$) and Self-efficacy for Computer-Based Personal Health Record Scale (Cronbach's $\alpha = 0.94$) were tested for construct validity in

previous work (Son et al., 2021). The authors also conducted psychometric testing to determine reliability and convergent validity of the tool as a whole (Son et al., 2021). Psychometric testing for the site-specific modified survey was not conducted.

Pre- and Post-Intervention Survey

All independent residents of the CCRC were invited to participate in a pre- and post-intervention survey. The self-report survey consisted of demographic information, self-assessment of eHealth literacy using the eHEALS (Norman & Skinner, 2006b), personal barriers to HIT use, self-reported shingles vaccination status, and self-reported intent to receive vaccination in the future. The self-efficacy and usefulness components of the PPAM were omitted from the pre-intervention survey because the dashboard was not yet accessible to residents at the time of its distribution.

The post-intervention survey contained the complete modified PPAM survey in addition to multiple-choice questions assessing knowledge of the incidence, risk factors, symptoms and complications from shingles and of the availability of *Shingrix*TM vaccination (Appendix B). Patient information was de-identified and assigned a unique participant identifier that linked the pre- and post-intervention surveys to allow for examination on an individual level.

Analysis

Qualitative and Quantitative Analysis

Qualitative and quantitative analyses were performed to visualize and examine patterns in the data. Descriptive analyses of demographic data, PPAM items, and pre- and post-test survey responses were performed. For categorical data (demographic information and multiple-choice items from pre- and post-test), analyses included frequencies and percentages. For the interval data (Likert-type scale PPAM survey items), mean scores, standard deviations, and range were

calculated. Comments submitted in the free text areas of the PPAM and the pre- and post-intervention surveys were evaluated for themes and to note exemplar responses.

Understanding Variation Within the Data

Individual surveys were linked with an anonymous patient identifier. This allowed for both assessment of individual changes over time in addition to the average response of all participants. Percent of correct answers on the shingles knowledge survey were calculated as a composite score created by assigning one point for each correct answer. Shingles knowledge was then able to be compared between those who had accessed the dashboard and those who had not. An initial goal of comparing knowledge of the benefits of vaccination with receipt of the vaccine during the intervention period was not able to be completed due to delays in dashboard development and deployment and competing vaccine priorities of the organization.

Ethical Considerations

This project was reviewed by the university Quality Review Committee as well as the CCRC's Vice President of Quality to confirm that it was a QI project prior to implementation. Participation was voluntary and consent was obtained prior to participation in focus groups or survey completion. Focus group participants were solicited based on their interest in promoting healthcare information technology and participation in this role was entirely voluntary. There is a unique patient-provider relationship element at the CCRC as the Wellness Clinics are located within the resident community, which could lead a resident to feel hesitant to decline to participate in the surveys or to engage with the dashboard. Residents were clearly informed verbally and in writing that participation was voluntary. Residents were not compensated in any way for utilizing the dashboard but there was a raffle of three \$25 gift certificates for completion of the second survey to encourage participation.

Risks to participants included side effects of *Shingrix*TM vaccination if they chose to receive it. *Shingrix*TM vaccination is generally well tolerated; side effects are mild and include low grade fever, headache, muscle aches, and nausea and typically resolve in 2-3 days (*Shingrix Shingles Vaccination*, 2021). At the CCRC, residents have the option of using an emergency call system if they are feeling unwell. A nurse responds to the call and can provide guidance regarding management of mild side effects or can recommend further evaluation if deemed necessary. The nursing staff received no vaccine-related emergency calls during the intervention period.

With certain Medicare Part D plans, residents may be required to cover some of the cost of the vaccine. Residents were advised to review this with their insurance prior to receiving the vaccine. The CCRC does not receive any monetary reimbursement for *Shingrix*TM vaccinations through local pharmacies.

Results

Participant Demographics

A total of 160 residents completed the pre-intervention survey and 22 completed the post-intervention survey. Accounting for the 15 residents that completed both the pre- and post-intervention surveys, a total of 168 residents provided demographic information. 115 respondents (71%) were female. The majority of respondents (102, 60.7%) were between the ages of 80-89. Respondents reported overall high levels of education with 138 respondents (83.1%) with a minimum of a college degree and 81 (48.8%) with a graduate degree. The majority of respondents (93, 57.8%) reported using computers/the internet for 20 years or more. The majority of respondents (151, 94.3%) reported using the internet for over an hour per week,

with 60 respondents (38.7%) reporting using the internet for 10 hours per week or more. 77.8% of respondents reported having used the internet to look for healthcare information in the past 12 months. Table 1 shows pre-intervention survey demographic data.

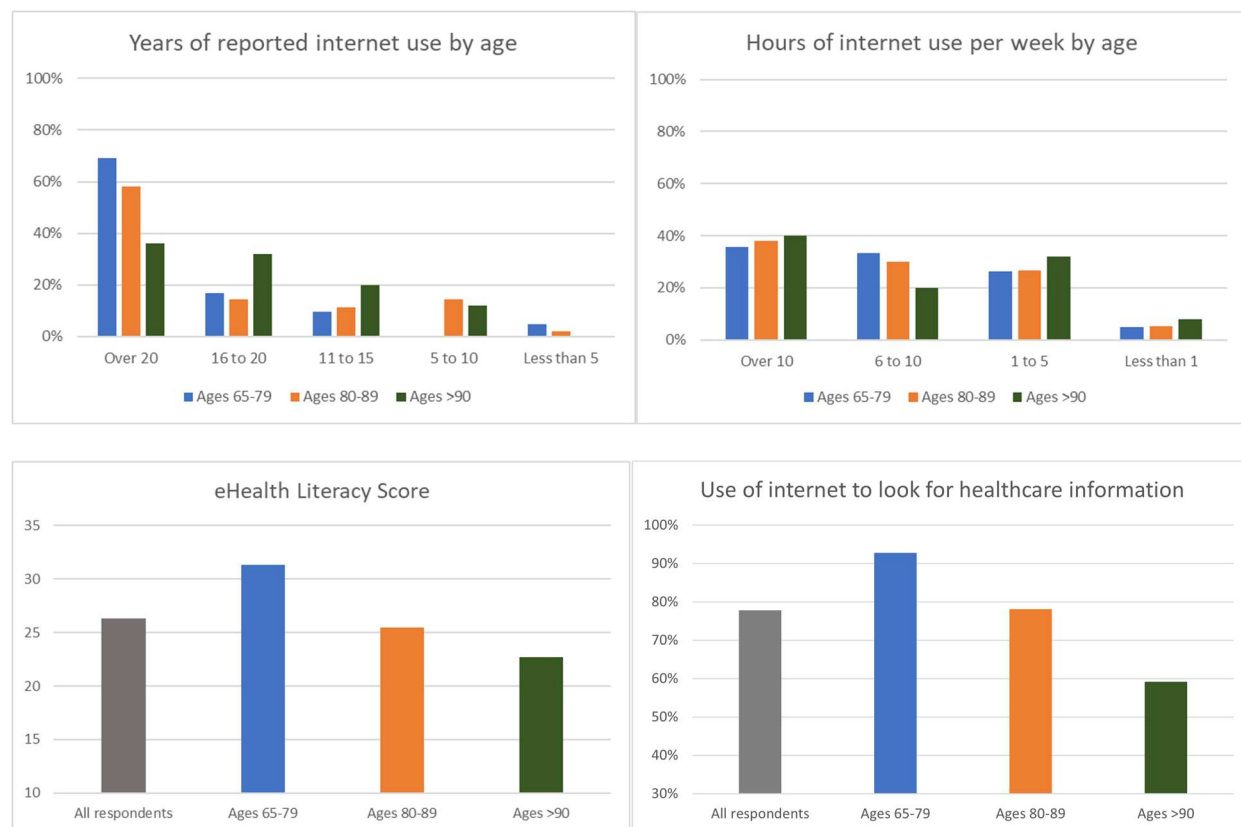
Table 1*Demographic Data*

Demographic Data	Total Sample (N=168) n (%)
Gender	
Female	119 (70.78)
Male	48 (28.5)
Blank	1 (0.6)
Age	
65-69	3 (1.8)
70-79	35 (20.8)
80-89	102 (60.7)
90-99	26 (15.5)
100 or older	1 (0.6)
Blank	1 (0.6)
Education (N=166)	
High School or GED	2 (1.2)
Some College	26 (15.7)
College Degree	56 (33.7)
Some Graduate Courses	1 (0.6)
Graduate Degree	81 (48.8)
Years of Internet Use (N=161)	
Less than 5 years	4 (2.5)
6 to 10 years	17 (10.6)
11 to 15 years	19 (11.8)
16 to 20 years	28 (17.4)
Over 20 years	93 (57.8)
Hours of internet use per week (N=160)	
Less than 1 hour	9 (5.6)
1-5 hours	44 (27.5)
6-10 hours	45 (28.1)
Over 10 hours	62 (38.8)
Use internet to look for health care information (N=162)	
Yes	126 (77.8)
No	31 (19.1)
Blank	5 (3.1)

As shown in Figure 1, when categorized by age a higher percentage of younger respondents reported using the internet for over 20 years. The youngest cohort of residents had the highest self-rated eHealth literacy scores, while the oldest cohort had the lowest. When categorized by age, 92.8% of respondents aged 65-79 reporting use of the internet to look for healthcare information, compared with 59.2% of those over age 90. However, total hours of current internet use per week was comparable across all age groups.

Figure 1

Internet Use by Age Category



QI Outcomes Reflective of Four Pillars™ Practice Transformation Program

Results of this QI project were appraised using the four pillars as a framework. Step one included calculating baseline vaccination rates. Step two, evidence-based strategies, involved assessment of residents' evaluation of their own eHealth literacy and perception of the

dashboard. Step three, evaluation of the improvement, assessed residents' shingles knowledge and intention to receive vaccination post-intervention.

Step One: Baseline Vaccination Rates

*Shingrix*TM is recommended for almost all immunocompetent adults over age 50. As of 2018, the most recent timeframe this data is available, the national average for shingles vaccination in this age group was approximately 35% (Terlizzi, 2020). At the CCRC, 53.8% of respondents reported being fully vaccinated with *Shingrix*TM, with or without a prior dose of *Zostavax*TM. Of the respondents who had not yet received both doses of *Shingrix*TM vaccination, 30.3% reported intending to get it in the future. 27.6% reported being unsure, 18.4% responded they did not intend to get vaccinated in the future, 11.8% did not respond and 11.8% responded “other,” typically indicating questions or concerns they would like addressed before deciding (Table 2).

Table 2

Self-Reported Vaccine Status

Self-Reported Vaccine Status	Total Sample (N=167) n (%)
Not vaccinated against Shingles	18 (10.8)
Unsure/Unknown	12 (7.2)
Received something, not sure what	14 (8.4)
Healthcare provider advised against	3 (1.8)
Zostavax only	20 (12)
Zostavax plus one dose of Shingrix	2 (1.2)
Zostavax plus two doses of Shingrix	33 (19.8)
One dose of Shingrix	8 (4.8)
Two doses of Shingrix	57 (34.1)
Intent to receive Shingrix	Total Sample (N=76) n (%)
Yes, at some point in the future	9 (11.8)
Yes, within the next 6 months	14 (18.4)
No	14 (18.4)
Unsure	21 (27.6)
Other	9 (11.8)
Blank	9 (11.8)

Step 2: Evidence-Based Strategies

Pre-Implementation Quantitative Analyses. Mean, standard deviation, and range was calculated for each of the eHealth literacy items as shown in Table 3. Respondents were asked to rank each item on a 1 to 5 scale. For items 1 and 2, 1 = not at all and 5 = very; for items 3-10 (eHEALS scale), 1 = strongly disagree and 5 = strongly agree. As in the original scale, items 3 through 8 were combined to calculate a total score ranging from 8 to 40.

Table 3

Descriptive Statistics for eHealth literacy and eHEALS items (Norman & Skinner, 2006b)

Item	M	SD	Range
1. How useful do you feel the Internet is in helping you to make decisions about your health?	3.47	1.05	1-5
2. How important is it for you to be able to access health resources on the Internet?	3.66	1.10	1-5
3. I know how to find helpful health resources on the Internet.	3.61	1.24	1-5
4. I know how to use the Internet to answer my health questions.	3.60	1.25	1-5
5. I know what health resources are available on the Internet.	3.22	1.23	1-5
6. I know where to find helpful health resources on the Internet.	3.35	1.20	1-5
7. I know how to use the health information I find on the Internet to help me.	3.42	1.23	1-5
8. I have the skills I need to evaluate the health resources I find on the Internet.	3.30	1.25	1-5
9. I can tell high quality from low quality health resources on the Internet.	3.29	1.31	1-5
10. I feel confident in using information from the Internet to make health decisions.	3.03	1.28	1-5

Pre-Implementation Qualitative Analyses. Respondents were asked two open-ended questions on the pre-implementation survey, one regarding personal barriers to using the internet to look for healthcare information and a second asking for any general comments regarding use of the internet to access healthcare information. Two major themes emerged: physical limitations and perceptual barriers. Physical limitations include any reason that prevents an individual from physically accessing the internet. Subthemes of physical limitations include mobility/sensory limitations (*internet is hard on the eyes*), lack of a computer or internet access (*very old computer, it cannot be updated*), and lack of computer skills to engage with the internet (*lack of my computer knowledge is the biggest barrier*).

Perceptual barriers were any reason that respondents made an active decision not to use the internet for healthcare information despite the physical and cognitive ability to do so. Several sub-themes of perceptual barriers noted were largely consistent with the findings of Young et al. (2014) and Turner et al. (2018). Concerns about privacy of health information were noted as well as the perception that being in general good health precluded the need to look for health care information on the internet (*since I am relatively healthy I have not had much need for health information*). These respondents, however, often noted that while they did not look for healthcare information for themselves, they commonly endorsed proxy use, looking for healthcare information for spouses or loved ones that they perceived as being in poorer health (*since my health is generally good, I have used the internet principally to seek info on my husband's declining health*).

A subtheme of concerns about the quality and reliability of the information emerged. Respondents noted concerns about the intentions of some sites (*using certain sites triggers spam from that site; I refuse to use some sites because of the onerous legal agreements which absolve*

them of all liability or responsibility for anything). Respondents in this study preferred health information to come from a familiar provider rather than the internet. Many commented that the internet was a good adjunct that could complement but not replace a discussion with a trusted provider; for example, a good first step to learn the background on a topic or research appropriate questions to ask to make a conversation with the provider more meaningful. Table 4 shows exemplar statements from each sub-theme.

Table 4*Barriers to using the internet to access healthcare information*

Theme	Sub-theme	Exemplar Statement
Physical Limitations	Mobility/Sensory Limitations	“Internet is hard on the eyes. It makes me tired.” – Female aged 80-89 “Can’t. Can’t read it [due to medical condition for which] am resuming occupational therapy” – Female aged 70-79 “[I] need to have info verbally to fully understand.” – Female aged 80-89
	Lack of access	“Do not own a internet” – Female aged >90 “Sometimes computer won’t work.” – Female aged >90 “Very old computer, it cannot be updated.” – Female aged >90
	Lack of computer skills	“Would be willing to use the internet if someone would teach me!” – Female aged 80-89 “Lack of my computer knowledge is the biggest barrier.” – Female aged 80-89 “[I] resent the time it takes me to do things on the computer.” – Female aged 80-89
Perceptual Limitations	Privacy concerns	“I refuse to use some sites because of the onerous legal agreements which absolve them of all liability or responsibility for anything.” – Male aged 80-89 “I do not trust [the Internet] for sure.” – Female aged 80-89
	Concerns about quality/reliability of information	“...sifting through false and unverified info can be difficult.” – Male aged >90 “I don't feel I always get to the best most helpful site. I feel it often sends me to providers who take out ads.” – Female aged 80-89 “Need to be vigilant against sales pitches - some are subtle.” – Female age >100
	Lack of confidence in ability to distinguish accurate from inaccurate information	“I'm not always sure where to look for accurate information to my health questions.” – Female aged 80-89 “Not always certain where to look...for proven, reliable medical info. I am not medically trained.” – Female aged 70-79 “Could use more education on recognizing false or misleading info on internet.” – Female aged 70-79 “Lack of ease in navigating internet and evaluating solid information vs. sites with other agendas.” – Female aged 70-79

Post-Implementation Quantitative Analyses. Twenty-two respondents completed the post-implementation survey. Of these respondents, 13 had accessed the dashboard at least once and 9 had not. For the respondents who accessed the dashboard, descriptive statistics for each PPAM element. Items 1 through 6 and 9 through 11 were scored on a 1-7 Likert-type scale (1 = not at all, 7 = definitely). Items 7-8 were scored on a 1-10 scale (1 = not confident at all, 10 = very confident). Mean, standard deviation, and range for each element are shown in Table 5.

Table 5

Descriptive Statistics for PPAM Items

Item	M	SD	Range
1. Overall, I found the Wellness Dashboard easy to use	4.8	1.6	3-7
2. Ease of following links on the dashboard	4.9	1.7	3-7
3. Ease of reading the information provided	5.0	1.6	2-7
4. Overall appearance	4.9	1.5	3-7
5. This dashboard helped me manage my plans for vaccination	2.1	2.3	1-7
6. This dashboard encouraged me to contact a healthcare provider	1.7	1.7	1-7
7. I can access and use the dashboard on my own	7.1	3.2	2-10
8. I can share this information with others if needed	7.2	3.1	2-10
9. I am worried about the privacy/security of this dashboard	2.5	2.2	1-7
10. This dashboard is a good idea	5.9	1.4	4-7
11. I would use this portal to receive other health information	5.7	1.8	2-7

Of the 13 respondents who accessed the dashboard, seven reported they had no difficulties. Six reported some type of difficulty accessing the dashboard, all of which were related to issues accessing or navigating the main resident portal, for example, *changing passwords* and *slide bar on right is delayed*.

Step 3: Evaluate the Improvement

There were no apparent differences in shingles knowledge on the post-intervention survey in respondents who had viewed the dashboard versus those who had not. The majority (10 out of 13) respondents who accessed the dashboard did so once versus multiple times. Table 5 shows the number of respondents who selected the correct answer on each shingles knowledge question. For items that were modified from the original PPAM, please refer to Appendix A.

Table 5

Descriptive Statistics for Shingles Knowledge Questions

Item	Accessed dashboard (% correct answer) N=12	Did not access dashboard (% correct answer) N=9
What causes Shingles?	10/12 (83%)	8/9 (89%)
What is your chance of getting Shingles in your lifetime?	5/12 (42%)	2/9 (22%)
What is your chance of getting Shingles this year?	2/12 (17%)	0/9 (0%)
What is a common symptom of Shingles?	11/12 (92%)	9/9 (100%)
What is the most common complication of Shingles?	12/12 (100%)	9/9 (100%)
True or false: Shingles is associated with increased risk of stroke.	0/12 (0%)	1/9 (11%)
Where can I get a Shingrix vaccine?	9/12 (75%)	8/9 (89%)
True or false: if I already had Shingles, it is not necessary to get the vaccine.	10/12 (83%)	9/9 (100%)
Average total score (Maximum = 8) (Range 2-6)	4.9	5.1

Fifteen respondents completed both the pre- and post-intervention surveys, allowing their individual intention to receive vaccination to be tracked over time. Of these, eleven were already fully vaccinated with two doses of *Shingrix*TM at the time of the pre-intervention survey. Two reported receiving *Zostavax*TM and not intending to receive further vaccination on both the pre- and post-implementation surveys. One reported receiving *Zostavax*TM and was unsure about

future vaccination on both the pre- and post-implementation surveys. One respondent went from being unvaccinated with intent to receive *Shingrix*TM at some point in the future to having received one dose of *Shingrix*TM and the next dose scheduled within six months.

Discussion

Summary

This quality improvement initiative was intended to promote *Shingrix*TM vaccination in independent residents of a CCRC through implementation of a patient-facing electronic dashboard, which was subsequently evaluated for its effectiveness in each of the distinct domains that drive HIT use in a given population. These include eHealth literacy, perceived usefulness, ease of use, self-efficacy, and privacy and security concerns (Son et al., 2021).

The qualitative data provided by residents in order to construct an appropriate dashboard for their needs proved to be valuable information about the motivators and barriers to HIT use in older adults. While shingles knowledge assessed by multiple-choice questions did not improve as expected with access of the dashboard, this provided an opportunity to evaluate where improvements can be made in the presentation of the material. For example, it was found that the majority of respondents only accessed the dashboard once; this underscores the importance of prioritizing and highlighting the most important information as concisely as possible. Due to contextual factors including prioritization of Covid-19 and influenza vaccination and competing priorities of the web developer resulting in a shorter implementation period than expected, it was unclear if this project influenced residents' behavioral intention to receive *Shingrix*TM vaccination.

A strength of this project is its sustainability and potential for expansion. After initial development, which was labor-intensive due to obtaining baseline data and delayed due to

competing priorities of the third-party web developer, the continued maintenance of the dashboard is straightforward and efficient. On routine intervals, the statistics and graphics on the dashboard can be easily updated to include the vaccinations obtained during that interval.

Ultimately, the accuracy of this information is dependent upon a more standardized process for reporting and documentation of vaccination status. Now that the skeleton is in place, it would be a straightforward process to develop dashboards for all recommended vaccines for adults 65+ as well as to use this resident portal as a medium for providing a wide variety of health-related information in one place. An area of future potential is to add other components to transition from a dashboard to a more interactive *patient portal*, with vaccinations included as one part of an overall picture including other health resources, frequently used documents and forms, and a secure method of communicating with Wellness Clinic staff.

Interpretation

eHealth Literacy

Consistent with previous literature in older adults (Turner et al., 2018; Young et al., 2014), lack of computer literacy and low confidence in utilizing technology were among the themes most commonly identified as barriers to accessing health information. However, in general participants were comfortable with use of the internet to obtain healthcare information. The CCRC residents' perception of their own eHealth literacy, as indicated by average eHEALS score, was comparable to that seen in the available literature on older adults (Chung & Nahm, 2015; Sudbury-Riley et al., 2017).

eHealth literacy is considered the “ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem” (Norman & Skinner, 2006a, paragraph 6). eHealth literacy requires additional

skills beyond traditional health literacy including computer literacy and media literacy.

Interestingly, the youngest cohort of residents (ages 65-79) rated themselves higher in eHealth literacy and searched for healthcare information on the internet more frequently than the oldest cohort, even though all age groups reported comparable overall use of the internet. This cohort of adults in their 80s, 90s and beyond is using the internet to read the news, play games, and communicate with others at equal rates as their younger peers. This suggests that rather than assuming that adults in their 80s and 90s need orientation to technology in general, education for this oldest cohort should be tailored specifically towards ability to seek out accurate healthcare information on the internet.

Perceived Ease of Use

Though based extensively on previous validated work, Son and colleagues' PPAM is a relatively new model published in February 2021 using a sample of participants of average age 53.1 (range 18-92). In their initial validation study, the authors reported average ease of use scores ranging from 6.1 to 6.2 out of 7. To the author's knowledge, the PPAM has not been tested in an exclusively geriatric population. In this project, the average ease of use scores ranged from 4.8 to 5.0, consistent with Son et al.'s (2021) finding in their structural equation modeling that age had a negative impact on ease of use scores. Open-ended responses indicated that most respondents' difficulties were related to login issues and navigation within the larger portal. Residents responded positively to presentations introducing the dashboard within the portal (one participant commented *it was a wonderful peek inside of the new resident portal, which for many residents is still a bit of a mystery*). However, only about 100 of approximately 480 independent residents attended these sessions. In addition to further sessions, embedding educational videos with voiceover into the dashboard itself is an option in the future.

Given the scores of 4.8, 5.0 and 4.9 on ease of use, ease of reading the material, and overall appearance of the dashboard respectively, there were surprisingly low scores on the shingles knowledge test suggesting respondents were not meaningfully comprehending the information. The majority of the dashboard was formatted as frequently asked questions in large, bold font with a two or three-sentence answer. The information on epidemiology and stroke risk was contained within the third and fourth paragraph on the dashboard, just below the text that appeared when the page loaded. Visual impairments, difficulties scrolling, text that was too complicated or lack of time/interest all may have contributed to this issue. It is possible that an alternative format such as bullet points may have increased comprehension. The dashboard's text was written at an average 10th-12th grade reading level (*Flesch Kincaid Calculator* | *Good Calculators*, n.d.) consistent with the high education of this population, which may have been too difficult or time-consuming for specialized clinical material. Further, it was clear that the significant link between shingles and risk of stroke is not well known by this very high-risk population, as this true/false question was answered incorrectly by the overwhelming majority (21 out of 22 respondents, or 95%). Providing effective education about the link between shingles and stroke is essential in this population. Anecdotally, avoiding stroke is an extremely high motivator for the residents of this CCRC, and residents are very aware of the potential outcomes of stroke. This association, framed appropriately, could be used to motivate more residents to seek out *Shingrix*TM.

Perceived Usefulness

The two questions assessing usefulness were modified from the original PPAM to be site-specific within the constraints of the singularly-focused dashboard that did not allow for HIPAA-compliant patient-provider interaction: *this dashboard helped me manage my plans for*

vaccination and this dashboard encouraged me to contact a healthcare provider (see Appendix A for original PPAM items). Average usefulness scores for this dashboard were notably lower than anticipated at 2.1 and 1.7 out of 7, respectively. This was partially attributed to the items having a much narrower breadth than on the original PPAM, where usefulness scores averaged 6 out of 7 and included a question about communication with healthcare providers directly within the patient portal. Usability issues are a common barrier to patient portal use for older adults; the age difference between the CCRC residents and Son et al.'s (2021) original sample may have also contributed to lower perceived usefulness scores. Son et al. (2021) found that ease of use positively influenced usefulness, so strategies to improve ease of use ratings may improve usefulness ratings as well.

CCRC residents demonstrated high levels of knowledge of the causative agent, signs, and symptoms of shingles regardless of whether they had accessed the dashboard. This suggests that this information is commonly known in this population. However, respondents performed no better than chance on questions regarding incidence rate, lifetime risk, and stroke risk of shingles, suggesting not only that this information is less commonly known but also that the dashboard was not effective at providing this education at this time.

Residents' competing vaccine priorities likely contributed to the dashboard information not being perceived as useful as anticipated. This dashboard was implemented during the same time period that COVID-19 booster shots for everyone over age 65 were approved by the CDC as well as when the community was offering free influenza vaccines onsite, potentially leaving limited opportunity for other preventative healthcare.

Perceived Self-Efficacy

In this project, respondents' average self-efficacy scores ranged from 7.1 to 7.2 out of 10. In their PPAM validation study, where self-efficacy scores ranged from 7.9 to 9.4, Son et al. (2021) found that self-efficacy was negatively influenced by age. Previous literature suggests that increasing self-efficacy may subsequently increase patient portal use, and that self-efficacy can be improved by population-specific learning programs (Nahm et al., 2019; Son et al., 2021). This is consistent with the positive reception to the live orientation sessions but also suggests that finding additional ways to improve self-efficacy in this population are needed.

Privacy/Security

Privacy and security concerns associated with HIT are a common theme in older adults (Turner et al., 2018; Young et al., 2014). This was consistent with respondents' open-ended answers about their barriers to HIT use. However, privacy/security concerns in this project were comparable to those seen in Son and colleagues' (2021) validation study at 2.5 and 2.7 out of 7, respectively (Son et al., 2021), suggesting that privacy and security issues of the dashboard were not a significant concern. If the dashboard is expanded in the future to contain a direct communication feature with healthcare providers, this should be re-evaluated.

Overall Findings

Qualitative analyses revealed that the main motivator of HIT use in CCRC residents was to feel more prepared or informed for in-person meetings with healthcare providers, while the major barriers were related to lack of access, lack of confidence in ability to find the right information, and lack of trust in the source of information. Accessing HIT was largely viewed as an adjunct to rather than a replacement for personal interaction with a trusted healthcare provider. This suggests that providing simple-to-navigate, easy-to-see and clearly evidence-

based information to CCRC residents can be a valuable source of health education for this demographic.

The goal of a 20% increase in the number of residents who received one or two *Shingrix*TM vaccines by the end of the intervention period was not met. Suspected reasons for this outcome in addition to the competing vaccine priorities include delays in platform development and deployment and limited campus service staffing leading to reduced resident transportation compared with normal operating procedures. However, this initiative demonstrated the possibilities of the resident portal as an effective venue for healthcare information of all kinds and engaged residents in communicating their preferences around HIT use.

One incidental finding was that while the CCRC had a standardized process for documenting yearly influenza vaccination and, more recently, COVID-19 vaccination, there was no such process in place for shingles or pneumococcal vaccination. Improving this documentation would allow the CCRC healthcare staff to focus its efforts on providing education to those who need it most and reduce the risk of unnecessary vaccinations for residents who do not remember if they have been vaccinated. This project was the impetus for improved documentation of *Shingrix*TM vaccination status, initially by documenting the self-reported data from resident surveys. There has also been suggestion of adding a standardized question to the community's *Future Resident Health Assessment* requesting documentation status for each of the recommended vaccines for ages 65+ so that this information gets entered into the resident chart upon move-in to the community.

Limitations

Limits to the generalizability of this QI project are related to the unique context that the initiative took place in. This project was implemented in a CCRC in northern New England

where entry into the community is dependent on both medical and financial qualification. This presumably leads to a population of generally healthier, higher-income older adults than the general population. These higher-income older adults are better educated than the general population; 83% have a college degree and almost half have a graduate degree. It is well-established that higher socioeconomic status and higher education level are associated with higher eHealth literacy (Xesfingi & Vozikis, 2016; Yoon et al., 2020). The levels of perceived self-efficacy and ease of use of the dashboard in this QI initiative may not translate to older adults with less HIT experience.

The convenience sample of CCRC residents recruited for this project is a potential source of bias. Baseline vaccination rates were calculated from this convenience sample of residents who chose to return a self-report survey, which may not be representative of the rate of the community as a whole. An initial plan to calculate rates by medical chart audit was not feasible due to lack of standardized documentation of vaccine history other than for influenza and Covid-19.

Only 22 residents returned the post-intervention survey, compared with 160 who returned the pre-intervention survey. This was primarily due to time constraints; with delays in implementation of the dashboard, respondents had 8 weeks to return the first survey and 2 weeks to return the second. Residents who elected to participate in the surveys could have been those who were more interested in or comfortable with HIT; less interested residents were probably less likely to return the surveys, particularly the longer post-intervention survey. One plan to address this potential bias was to not only look at aggregate data, but also to assess individual behavioral intention over time. However, the majority of respondents who completed both pre-

and post-implementation surveys were fully vaccinated resulting in very limited data on whether this intervention had an effect on behavioral intention to seek out vaccination.

Conclusion

This quality improvement project led to a number of findings that inform how CCRCs can improve assessment of resident knowledge, dissemination of information, and documentation. Further, it demonstrated how accessing HIT fits into this framework as CCRC residents become increasingly comfortable with use of technology. It is not unexpected that average scores in each of the PPAM domains were slightly lower in a population of CCRC residents with an average age of 84.6 (range 68-101) compared with the original sample of participants of average age 53.1 (range 18-92). This suggests, consistent with previous literature, that older adults are interesting and willing to use HIT but may need specific support and education tailored to their unique needs.

The fact that older adults are more comfortable using technology than in previous generations has important implications for providing effective healthcare to this population. In this QI project, 77% of participants had used the internet to look for healthcare information within the past year and when categorized by age, 92.5% of participants ages 65-79 had used the internet to look for healthcare information within the past year. Newer residents increasingly expect technology as part of the CCRC experience; indeed, it was the residents who initially noted the lack of healthcare information on the original resident portal. This suggests CCRCs can increasingly leverage HIT to provide a wide array of health information and education, especially in the era of the COVID-19 pandemic when many in this high-risk population were looking for trustworthy alternatives to seeing their providers in person. Not only are CCRC

residents willing to access HIT, qualitative analyses showed that they actively want this and seek it out.

One common concern was not knowing what sites or information to trust, underscoring the importance of building trust and ensuring information is accurate, evidence-based and up to date. As such, it must be noted that these dashboards should not be used in isolation but rather as an adjunct to a trusted provider-patient relationship. The Wellness Clinic staff of the CCRC have a unique opportunity to build these relationships given their physical and emotional proximity to the residents of the community. Ideally, this would start immediately upon a resident's move into the community by incorporating an orientation to these dashboards as part of the new resident orientation.

Although this project revealed some challenges in communicating via HIT to older adults, ultimately the residents of this CCRC were highly receptive to the dashboard and expressed interest in continuing to use it as a source of healthcare information and as a way to engage with the Wellness Clinic teams. Engagement is a key component of empowering individuals to make informed, positive healthcare decisions and thus leveraging HIT to improve resident engagement in CCRCs has the potential to improve health outcomes and quality of life.

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Appendix A**Modified PPAM survey**

(Items 1-12 pre-and post-intervention; Items 13-18 post-intervention only)

1) Eligibility/consent. Please check below to show if you want to participate in this survey. If you choose to participate, please sign your name on the front page and flip to the survey on page 2.

- ☐ Yes, I want to participate
- ☐ No, I do not want to participate

2) What is your age?

- ☐ 65-69
- ☐ 70-79
- ☐ 80-89
- ☐ 90-99
- ☐ 100 or older

3) What is your gender?

- ☐ Male
- ☐ Female
- ☐ Prefer not to answer

4) What is your highest level of education obtained?

- ☐ High school or GED
- ☐ Some college
- ☐ College degree
- ☐ Graduate Degree
- ☐ Other (specify) _____

- 5) How many years have you been using computers/the internet?
- ☐ Less than 5 years
 - ☐ 5-10 years
 - ☐ 11-15 years
 - ☐ 16-20 years
 - ☐ Over 20 years
- 6) How many hours per week (on average) do you use computers/the internet?
- ☐ Less than 1 hour
 - ☐ 1-5 hours
 - ☐ 6-10 hours
 - ☐ Over 10 hours per week
- 7) In the past 12 months, have you used the internet to look for health information?
- ☐ Yes
 - ☐ No
- 8) How useful do you feel the Internet is in helping you to make decisions about your health?
- ☐ Not useful at all
 - ☐ Not useful
 - ☐ Unsure
 - ☐ Useful
 - ☐ Very useful
- 9) How important is it for you to be able to access health resources on the Internet?
- ☐ Not important at all
 - ☐ Not important

- Unsure
- Important
- Very important

10) eHEALs Survey Items. For each of the following, please select the answer that best describes your opinion (1: Strongly disagree, 5: Strongly agree)

- I know how to find helpful health resources on the Internet.

1 2 3 4 5

- I know how to use the Internet to answer my health questions.

1 2 3 4 5

- I know what health resources are available on the Internet.

1 2 3 4 5

- I know where to find helpful health resources on the Internet.

1 2 3 4 5

- I know how to use the health information I find on the Internet to help me.

1 2 3 4 5

- I have the skills I need to evaluate the health resources I find on the Internet.

1 2 3 4 5

- I can tell high quality from low quality health resources on the Internet.

1 2 3 4 5

- I feel confident in using information from the Internet to make health decisions.

1 2 3 4 5

11) Optional: Please comment on any barriers to your use of the internet to obtain healthcare information.

12) Optional: Please provide any further comments regarding your use of the internet to obtain healthcare information.

13) Ease of use: please rate the following items from 1 (extremely difficult) to 7 (extremely easy):

- Overall, I found this dashboard easy to use

1 2 3 4 5 6 7

- *Ease of following links on the dashboard* (adapted from *ease of completing tasks*)

1 2 3 4 5 6 7

- Ease of reading the information provided

1 2 3 4 5 6 7

- Overall appearance of dashboard (1: terrible; 7: excellent)

1 2 3 4 5 6 7

14) Usefulness: please rate the following items from 1 (Not at all) to 7 (Definitely):

- This helped me manage my *plans for vaccination* (adapted from *manage my health*).

1 2 3 4 5 6 7

- *This encouraged me to contact a healthcare provider* (adapted from *communicate with healthcare team within patient portal*).

1 2 3 4 5 6 7

- Did you experience any difficulties using this dashboard?

- No

- Yes (specify) (free text box)

15) Self-efficacy: please rate the following from 1 (Not confident at all) to 10 (Very confident):

- I can access and use the dashboard on my own.

1 2 3 4 5 6 7 8 9 10

- I can share this information with others if needed.

1 2 3 4 5 6 7 8 9 10

- This helped me keep track of my *vaccination* status (*adapted from “health status”*).

1 2 3 4 5 6 7 8 9 10

16) Data privacy and security concerns: please rate the following from 1(Not at all) to 7 (Very):

- I am worried about about privacy/security of this dashboard.

1 2 3 4 5 6 7

17) Rate the following from 1 (Not at all) to 7 (Definitely):

- *This dashboard is a good idea (Adapted from the patient portal is a good idea).*

1 2 3 4 5 6 7

- *I would use this dashboard to receive other health information (added to be project-specific).*

1 2 3 4 5 6 7

18) Please share any other perspectives on this dashboard you feel would help improve it. (Free text box).

Appendix B

Shingles Knowledge: Post-test

1) Participant identifier (link to responses on PPAM survey)

2) Post-test only: Did you access the dashboard during the study period?

- ☐ Yes, once
- ☐ Yes, more than once
- ☐ No

3) What causes Shingles? (Select one)

- ☐ Herpes zoster
- ☐ Pneumococcus
- ☐ Sars-CoV-2
- ☐ Herpes simplex virus

4) What is your chance of getting Shingles in your lifetime? (Select one)

- ☐ 1 in 3
- ☐ 1 in 5
- ☐ 1 in 8

5) What is your chance of getting Shingles this year? (Select one)

- ☐ 1 in 1000
- ☐ 5 in 1000
- ☐ 12 in 1000
- ☐ 1 in 200

6) What is a common symptom of Shingles? (Select one)

- ☐ Cough and sore throat
- ☐ Painful or itchy rash
- ☐ GI symptoms

7) If you contract Shingles, what are your chances of having pain more than 30 days later (post-herpetic neuralgia)?

- ☐ 5%
- ☐ 10%
- ☐ 20%
- ☐ 30%

8) True or false: Shingles is associated with increased risk of stroke.

- ☐ True
- ☐ False

9) Where can I get a Shingrix vaccine?

- ☐ A local pharmacy
- ☐ My primary care provider
- ☐ Urgent care

10) True or false: if I have already had Shingles, it is not necessary to get the vaccine.

- ☐ True
- ☐ False

11) Have you ever had a vaccine for Shingles?

- ☐ Yes
 - Yes, one dose of Zostavax
 - Yes, one dose of Shingrix
 - Yes, two doses of Shingrix
 - Yes, not sure which vaccine it was
- ☐ No

- ☐ I don't know

12) Do you intend to get a vaccination for Shingles in the next 6 months?

- ☐ Yes
- ☐ No

13) Please comment on any barriers you have had to receiving the Shingrix vaccination (Free text box)